DSN Traceability and Reporting Program: Micrographic Application

J. A. Miccio
DSN Engineering and Operations Office

Technology has advanced the development and utilization of higher and faster data rates for deep space satellite research; machine computation and analysis have been relied upon by investigators and analysts for a greater percentage of the data reduction. The investigator, analyst, and end user, however, still face a massive volume of output data. The longevity of spacecraft systems in high data transmission modes and the "one of a kind" nature of the data being returned increase the desire for extensive data acquisition and retention of scientific and engineering information. The result of increased volumes of data being processed with corresponding increases in magnetic tape and tab paper output poses cost and storage problems for the processing facility and the data analyst. An efficient and expeditious method for data reduction, retention, and retrieval is mandatory.

Micrographic technology, i.e., microfilm processes, microforms, and retrieval systems, combined with current computing techniques, affords the data user quick-look profiles and trend information in relatively short turnaround time, as well as accessibility to larger and more detailed data bases.

I. Introduction

In the DSN Operational Data Control (ODC), microfilming has been performed more or less as a passive function for past missions, specifically as a data recording service apart from the mission operations environment.

During the *Mariner* Mars 1971 program, microfilming has become a much more active function, acting as a media for information retention and retrieval, and additionally, as a method for selective information dissemination in such forms as 16 or 35 mm rolls, microjackets, and microfiche. Interacting with the microfilm function in DSN ODC is the Traceability and Reporting Program (TRP), a file management program providing user visibility in near real-time and/or in an archival mode of data generated by DSN Systems (Ref. 1).

By combining the microfilm system and the Traceability and Reporting Program, the investigator, analyst or end user is provided microfilm of specific information in various forms and summary or composite reports of all user material either on microfilm or in the TRP data base.

II. Function

The combination of micrographic and file management processes allows for effective handling and presentation of large volumes of data. This combination additionally provides the end user accessibility to individual or selective information units among large quantities of data through the use of various microforms and computer-generated profiles.

There are three individual segments interacting with one another making up the preceding combination:

(1) *Micrographics.* Use of microfilm in the form of roll film, microjackets, microfiche, and aperture cards to reduce, record, display, duplicate and/or reproduce, and disseminate selected information units, coded and abstracted in user linguistic form.

(2) *Traceability and Reporting Program.* A Mark IV general-purpose file management program operating on either 360/75 or 370/155 systems.

(3) *User Community.* Laboratory management, DSN, Project and Administrative, Project Investigators, Analysts, other agencies, and universities.

Each of these segments relies upon the other. Information retention and retrieval by either process described above cannot be accomplished without knowledge of the users needs for information, i.e., type, format, form, quantity, frequency, or the linguistic composition.

Figure one illustrates the functional relationships of the three segments. This flow identifies the distribution to the user, and various output products in various formats and forms. The user acts as the recipient and requestor simultaneously, receiving first run generated products and requesting information from microfilm files through the use of a TRP user report. User requests may occur simultaneously for real-time, near real-time and archival information at different time levels for a given project and illustrate the importance of abstracting and coding information in terms of user linguistics (user recognized terminology) capable of meeting requests 24 hours after the fact or two years after the fact without any significant change to the initial coding during microfilming and entry into the TRP data base.

The following sections of this article will focus upon the micrographic processes used by DSN Operational Data Control in support of *Mariner* Mars 1971, *Pioneer 6–9* mission operations and those planned for *Pioneer F.*

III. Elements

Mariner Mars 1971 mission operations have afforded an excellent opportunity to utilize microfilm extensively as an active information retention and transfer media rather than passive storage medium. The microfilming is accomplished by two rotary cameras, each capable of exposing or filming two 30.5-m (100-ft) 16-mm microfilm rolls simultaneously. An Eastman Kodak Rotoline microfilm unit is used for computer tab output and other continuous form data, 7.6 to 35.6 cm (3 to 14 in.) in width at reduction ratios of 24 or 32:1. [If a 32:1 reduction ratio is used, the width of data can be up to 45.7 cm (18 in.)]. A Remington Rand F-77 microfilm unit is used for single sheet, short continuous forms, and pass folders, and features an automatic document feeder which allows rapid document microfilming.

During the first three weeks of *Mariner* orbit operations, data from the Science and Navigation areas equivalent to a 93.3-m (306-ft) high stack were recorded on 320 rolls of microfilm. The 16-mm 30.5-m (100-ft) roll microfilm acts as basic microform, from which duplicates (positive or negative) can be generated, microjackets created and duplicated, and microfiche created. Roll film becomes a versatile microform, offering the user information retention, and accessibility, as well as a vehicle for information dissemination and transmission.

Microform viewers and printers are located in the DSN ODC and in the Science and Navigation areas. Two 3M viewer/printers, two Stromberg Datagraphix viewers and an Eastman Kodak reader-printer are utilized in DSN Operations for user information reference and retrieval. The 3M and Eastman Kodak equipment will accommodate all microforms and 35-mm roll microfilm. In addition these viewers all have print back capability producing hardcopy of selected information frames upon user selection.

The Eastman Kodak equipment can take either positive or negative microfilm providing both viewing and hardcopy printing capability with no chemical change required.

Microfilm as a versatile media has been shown to provide the user many capabilities and methods for information storage and retrieval. By indexing (coding) all data prior to microfilming, numerous descriptors may be utilized to characterize and identify selected information in order to facilitate retrieval from both microfilm and computer processes. Index samples (Figs. 2 and 3) represent indexing methods used for Science and DSN pass folder

material. The indexes are filmed with the data, and a copy is submitted for entry into the Traceability and Reporting Program (TRP). The Traceability and Reporting Program then produces a catalog for all material on film, identifying roll, frame locations, as well as listing all descriptors.

IV. Implementation

Prior to *Mariner* Mars 1971 launch, all microfilm users were instructed on the application of indexing principles to their data and oriented on the usage of the Traceability and Reporting Program reports for information retrieval. Throughout the mission all data entering the ODC system have been indexed at the point of origin, thereby enhancing the accuracy and completeness of data descriptors, and accelerating turnaround time.

The total micrographic process of indexing, microfilming, processing, reproduction, and dissemination has been accomplished within the SFOF. The Traceability and Reporting Program has been generated on the 370/155 system on a daily basis. User reports are distributed weekly, and on demand.

V. Conclusion

Implementing a micrographic process within mission operations has proceeded satisfactorily; user acceptance, however, must be measured to determine the effectiveness of this process. At this time, requests indicate a high usage level, with a trend toward greater utilization as orbit operations analysis continues.

The outlook for a greater utilization of microforms for information, retention, retrieval, and dissemination, coupled with the file management process, seems promising. The achievement of combining a microfilm function with the Traceability and Reporting Program has proven successful, and as development proceeds toward an on-line interactive capability, further user acceptance and utilization is anticipated.

Reference

1. Miccio, J. A., "DSN Traceability and Reporting Program," in *The Deep Space Network Progress Report*, Technical Report 32-1526, Vol. II, pp. 145–147. Jet Propulsion Laboratory, Pasadena, Calif., Apr. 15, 1971.

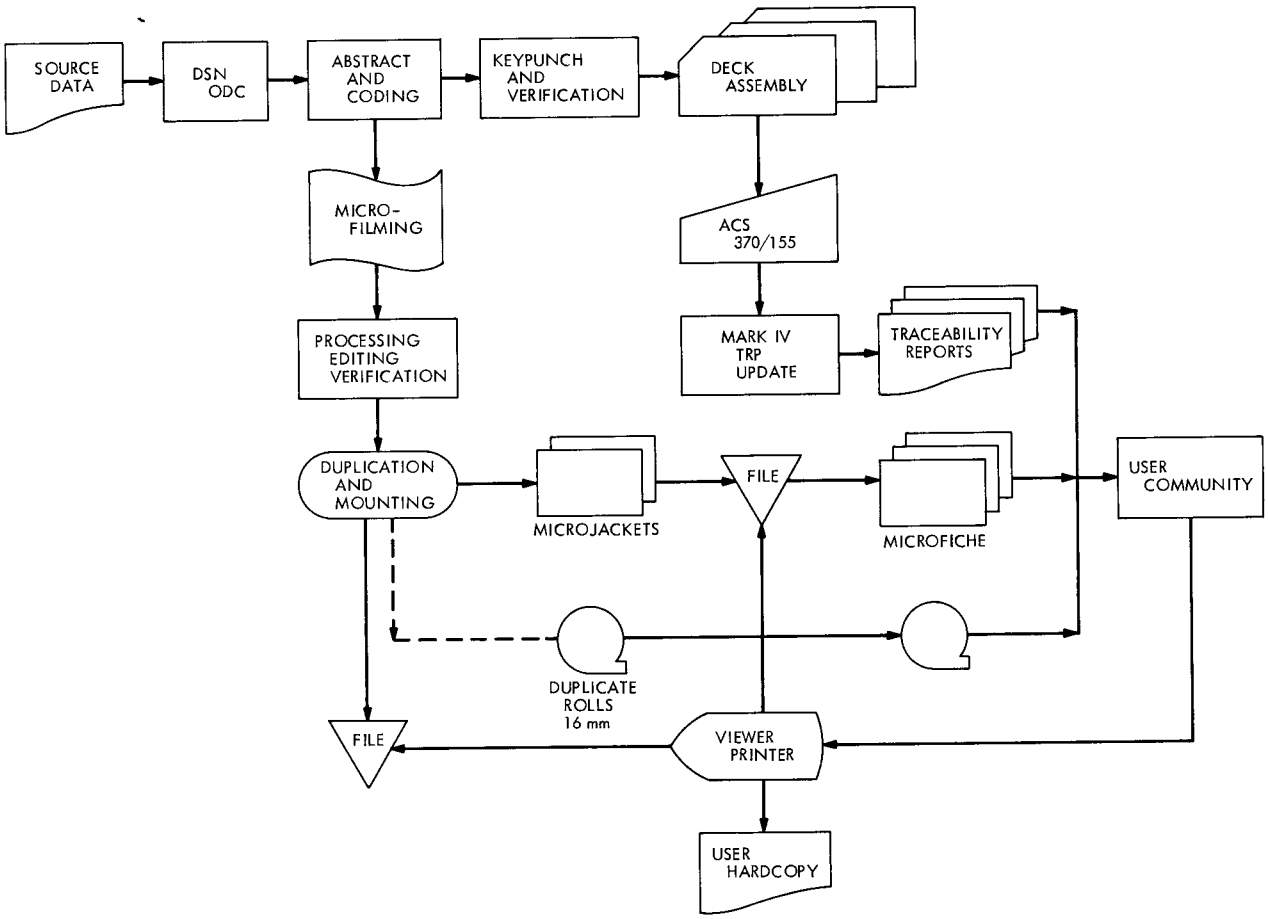

Fig. 1. Traceability and reporting micrographic flow

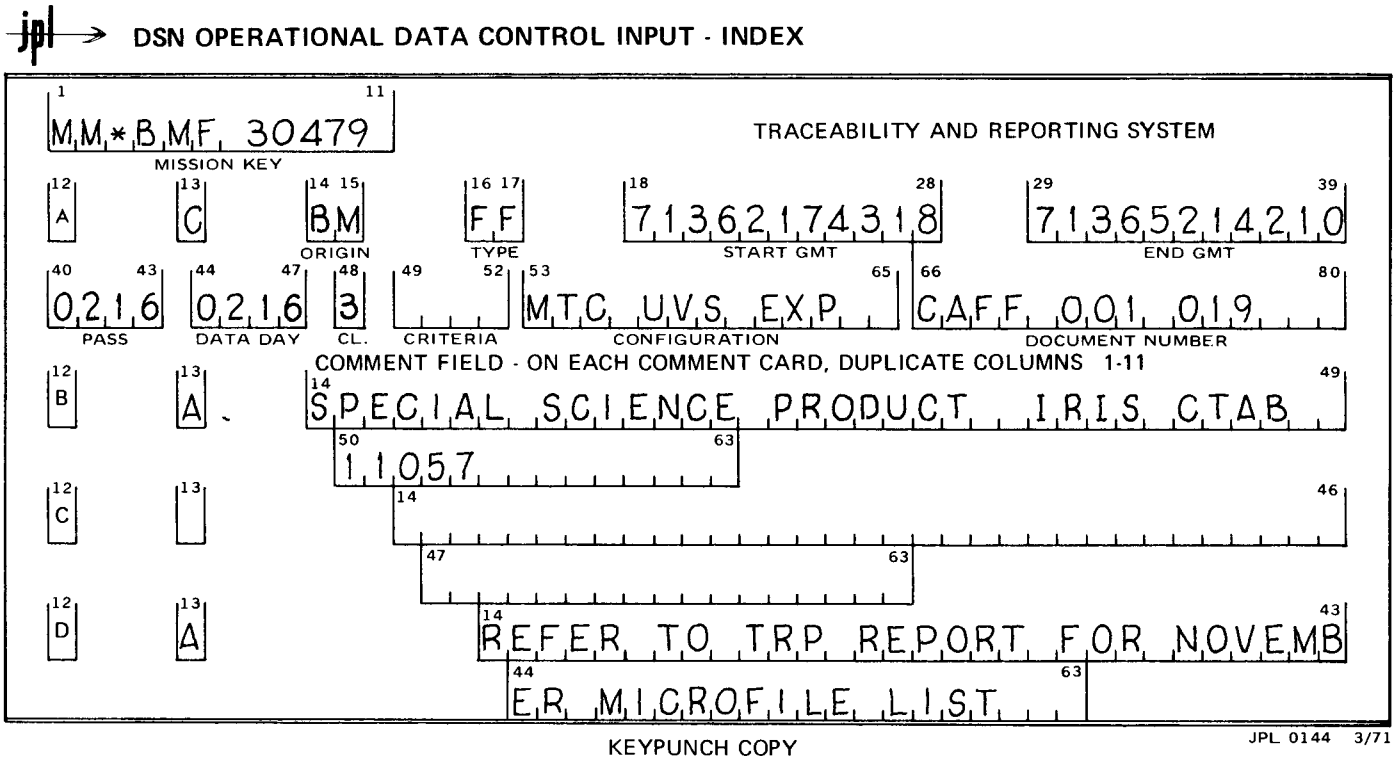

Fig. 2. Science data index sample

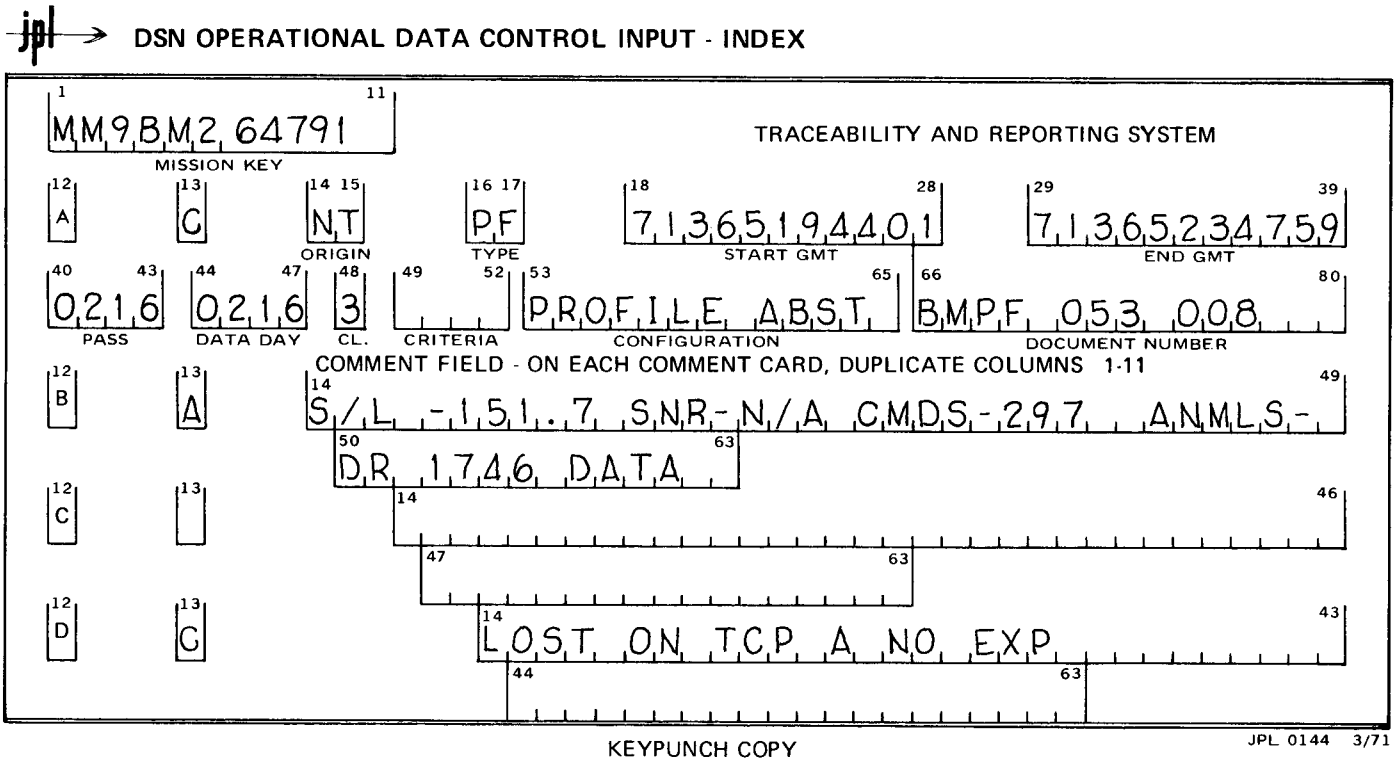

Fig. 3. DSN pass folder index sample